Nutrition for People with Kidney Disease

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Theresa Kuracina:

I just want to say thank you Jan and Kelli, and the Division of Diabetes Treatment and Prevention program for providing this webinar, and certainly for all of you who are listening today.

As Jan mentioned, my name is Theresa Kuracina. I have been a Registered Dietitian since 1987 and a Certified Diabetes Educator since 1997.

Early in my career, I did work with dialysis and kidney transplant patients, and since I came to IHS in 1991 I've had the privilege of working with Dr. Andrew Narva, the former IHS nephrologist and the current director of the National Kidney Disease Education Program.

In the past, he and I have provided workshops for IHS providers about kidney disease, and more recently we have developed online programs for the Academy of Nutrition and Dietetics and the American Association of Diabetes Educators about kidney disease. And as Jan mentioned, I work at the Albuquerque Service Unit, the Albuquerque Indian Health Center, and I work in the Diabetes Education Program, where I see people with pre-diabetes, with diabetes, and people with diabetic kidney disease. I see, just like you do, a range of conditions and I will tell you that the focus of my talk, the nutrition, will be about kidney disease due to diabetes.

So just to let you know, I will also try to speak in plain language today because I believe that most of the people we serve are not that fluent in medical terms, and the topics I will briefly cover include a review of the anatomy of the nephron, what the kidneys do, and how to identify kidney disease. And for those of you who need more information about these particular topics, if you go to the DDTP website, you can get the web-based training, “Managing Progressive CKD in People with Diabetes” by Dr. Narva.

My topics today will also be looking at the ABCs and actually looking beyond the ABCs to identify diabetic kidney disease. I’ll review the possible interventions for lowering urine albumin, and briefly review the complications of chronic kidney disease. Because all of these things frame what I'm going to tell you about the diet, because I will review the nutrient profile of the food groups, and review the steps for dietary intervention in chronic kidney disease.

Each kidney, as you know, is made up of about a million functioning units called “nephrons.” Here, you see a graphic of a nephron. Each nephron has a glomerulus, the filter of the kidney. Each nephron has a tubule, and the tubule has several different parts which function to change the filtrate that passes through the glomerulus. The tubule eventually joins the collecting duct, which joins larger and larger ducts that eventually drain into renal pelvis. From there, the urine drains through the ureter into the bladder. The kidneys keep the composition of blood within very narrow ranges and the kidneys do this through a series of steps that start with filtration by the glomerulus. As I've mentioned, the filter is changed as it passes down the tubule. Some things are reabsorbed back into the blood. For example, most albumin that crosses the filter is reabsorbed back into the blood, and I believe that many of you have heard about the new diabetes medications that work at the kidneys. These medications basically

block the reabsorption of glucose back into the blood within the tubules, and that glucose eventually is removed into the urine.

Finally, the other thing that happens is that certain substances are secreted into the tubule from the blood; creatinine and potassium, for example, may be secreted into the tubules. Overall, the end result is urine, which is highly concentrated with substances that we do not need.

So I have to kind of review the definition of chronic kidney disease to frame this. I know it's supposed to be a nutrition talk, but I have to define CKD first. Here you can see that it's based on reduced kidney function, or kidney damage, or both. So the functional definition is based on a decrease in kidney function or kidney filtration. An Estimated Glomerular Filtration Rate or EGFR less than 60 is reduced kidney function. There are fewer nephrons that are working. We identify kidney damage in a couple of different ways.

In most cases, kidney damage is identified by an abnormal amount of albumin in the urine. A urine albumin to creatinine ratio greater than 30 milligrams per gram is considered abnormal, and that alone can identify the patient has chronic kidney disease. And albuminuria may be the first sign of kidney damage due to diabetes. Just as we need to confirm a patient has diabetes with more than one abnormal result, these abnormalities need to persist over time in kidney function and kidney damage. I know we're all familiar with the standards of care for diabetes. These are basically the annual nephropathy assessment. We look in the blood and the urine to check the kidneys. We get a serum creatinine level that's put into a formula to estimate the GFR and we check the UACR to look for kidney damage.

The kidneys have four main functions: the first two shown on this slide are the ones I think most people are familiar with. The kidneys function to maintain homeostasis or balance in the body. They control the composition and volume of the blood by keeping levels of anions such as sodium, potassium, and calcium within a narrow range. They also keep the acid and base balanced, which we need for physiologic functioning. The nephrons get rid of extra acid or hydrogen ions, and they make more base or bicarbonate. In addition, they remove metabolic wastes, including nitrogenous waste for excretion from the body.

Now, many people with kidney disease may be puzzled, how can we tell they have kidney disease when they still make urine. We just need to tell them that we've looked in their blood and their urine, and we can tell that the kidneys are not functioning as they had in the past.

Now, these are the functions that may not be as familiar to the patients. The kidneys do have an endocrine function. They make renin, the hormone involved in maintaining vascular volume and blood pressure. They make erythropoietin, the hormone needed to make red blood cells. In addition, they are the site where vitamin D is activated. The kidneys have metabolic functions as well. They contribute to gluconeogenesis. They make new glucose when we are under stress and they also break down or metabolize drugs and other substances. And for those people who are taking insulin, they may need a lower dose, as there will be fewer nephrons to break down that injected insulin.

Oral diabetes medications may also be discontinued since many of those medications are cleared by the kidneys. The patient still has diabetes. We just want to make sure they're not having problems with hypoglycemia. As providers, you should expect to see an increase in abnormal labs, as the EGFR goes down. And the patient needs to know that we will be checking lab tests more often. We may be checking metabolic panels to monitor status, and it should be no surprise to you that more medications may be prescribed to treat these problems.

Now, you remember when I mentioned that albuminuria may be the first sign of diabetic kidney disease? Well here, you see a diagram of the natural history of diabetic kidney disease, and if you

have seen Dr. Narva's talk that I mentioned previously, you have seen this slide before. Along the horizontal axis is years of high blood sugar or hyperglycemia. The vertical axes show GFR on the left and albuminuria on the right. The red line, which tracks GFR, initially goes above normal after the onset of hyperglycemia. Depending on which textbook you use, a normal GFR may go up to about a 120, and here you can see the GFR is 140 and higher with hyperglycemia. The kidneys are hyperfiltrating.

Then, if the diabetes is not controlled, the GFR, that red line, goes down. Around the time that the GFR passes back down through the normal range, you can see the urine albumin level shown by the gray line going up. As a result, the first clinical sign of diabetic kidney disease is usually an increase in urine albumin, and although the estimated GFR may be normal at that point, it may be on the way down. As time progresses and the diabetes remains uncontrolled, more and more nephrons are destroyed. So identifying and managing diabetes early may actually prevent this from developing. It is the uncontrolled diabetes that increases the risk for developing diabetic kidney disease. And tight control of long standing diabetes may not lower urine albumin level effectively.

So now, I am going to move on to the ABCs and frame why it is important to look at the nephropathy assessment. So here, you see T.C., he is a 57-year-old man with high blood pressure and diabetes. He does not smoke or drink alcohol. You can see his A1C is 7.2, his blood pressure is 136/82, and his LDL or the lousy cholesterol, as I call it, is 102. Now, some of us might want these numbers to be a little bit lower, depending on what his previous results were, but overall these numbers are not bad in general. And his BMI is in the overweight category.

Now, here are his nephropathy assessment results. His UACR is 1,356. That is way higher than the normal level of 30 or less. His serum creatinine level is 1.0, and when this is placed into an estimating equation along with gender, age and race, his estimated GFR is greater than 60. It is still in the normal range. T.C. has kidney damage and normal kidney function at this time. I'm sure many of you are familiar with these graphics. These are from the National Kidney Disease Education Program handout called "How Well Are Your Kidneys Working?" You can see the graphic on the left shows inside a healthy and damaged kidney. Notice that the black circles, the albumin, crosses the filter and goes into the urine in a damaged kidney.

The GFR speedometer on the right shows kidney function, 60 and higher is normal and 15-60 defines kidney disease, and an eGFR less than 15 is kidney failure. Now, some of you may also be familiar with the staging system that breaks these down into more discrete levels and really, the GFR does not always go down in a straight line. It can go up and down over time and we need to watch the trends. Someone's GFR might be 44 and then it might go to 37 and then it might go back up to 45. This just shows that the patient has reduced but stable kidney function. The people that we should worry more about are those whose GFRs go from normal to 43, down to 21 in a year or two. T.C. is at risk for rapid decline in GFR based on his high level of urine albumin. So this is the type of patient that we need to identify and monitor for progression.

So, how can we lower that urine albumin since I am just telling you that it is a prognosticator for rapid progression of kidney disease? I have already mentioned that for people who are newly diagnosed or early in the course of diabetes, if we help them learn how to manage their diabetes, we may prevent albuminuria from developing. But if someone has had diabetes for a long time, what we need to do is work on blood pressure control, reducing sodium intake, having them lose some weight if they are obese, having them decrease their protein intake if their intake is excessive.

I do not know if you can remember this, but I told you that albumin that crosses the filter is supposed to be reabsorbed within the tubule. When people have a lot of protein crossing the filter and going into the tubule, it exceeds the capacity of that tubule to reabsorb the albumin and they think that that is part of why kidney damage continues. So the extra protein in the diet that may end up in the tubules will hurt

the kidneys further, so we want them to eat less protein if they are eating too much; and of course, we always want people to quit smoking tobacco if they can; and finally, if someone has a tooth infection or a toe wound, if we can treat those infections, we may also find that their urine albumin levels will go down.

We all know that blood pressure control is key to slowing the progression of kidney disease. The target blood pressure is less than 140/90 and people will need two or three or more medications to control the blood pressure. Many people will be taking an angiotensin-converting enzyme inhibitor, an ACE, or an angiotensin receptor blocker called an ARB. They should be taking one or the other, not both. Both types of these medications lower the blood pressure and lower urine albumin. But we also need to know one of their side effects. Both types decrease the amount of potassium that is excreted into the urine. So that means more potassium stays in the blood and people will need to be monitored for hyperkalemia. We want them to limit their sodium intake to no more than 2,300 milligrams per day and we should also let them know they should not pick a salt substitute with potassium chloride in place of salt or sodium chloride and that is particularly true if they are taking an ACE or an ARB.

So when we look at the foods that are frequently consumed in this country, you can see that when we start at noon, that yeast breads contribute the most sodium to our daily intake. So think of it this way: we have toast for breakfast, a sandwich for lunch, maybe some bread with supper. All of that adds up. As diabetic educators, it is a good thing that we are telling them to eat a little bit less pizza and pasta for the carbs because these foods are also quite high in sodium. And interestingly, chicken and chicken dishes come in second, and I will be telling you a little bit more about poultry that may be enhanced with sodium additives to keep those products moist and tender in a few slides. So needless to say, you can see that many foods contribute to daily sodium intake.

So the first step is to choose foods with less salt and less sodium, and if someone is trying to find out which ones they are they can start by looking at the labels on the boxes and cans of foods that they have at their cupboards. Not everybody has three hours to spend reading labels in the store. So here, you can see a sample of the nutrition facts label. The serving size is always found at the top and one cup is a serving for this particular item and the container has two servings. So, if someone eats the whole thing, the sodium along with all the other nutrients shown, doubles. That means 1,320 milligrams of sodium for the whole thing.

Now, not everyone is good with math and not everybody can add numbers up and multiply. So one way to get around that is to check the percent daily value, that column that you see on the right. The percent daily value for sodium is based on 2,400 milligrams per day, and the definitions are a percent daily value of five percent or less is low and a percent daily value of 20 or more is high. One serving has 28% of the daily value for sodium. So this is a high sodium food either way, milligrams or percent daily value. Recently I've been talking to more and more people about percentages because they don't like the numbers and even percentages can be confusing. So, I have been telling them that the percent daily value is like a dollar. They only need a hundred pennies a day of sodium. So for this item, they have spent 28 cents of their budget for the sodium for the day.

So for those of us who are not pharmacists or doctors, we may want to know how to identify those blood pressure medications that lower urine albumin and increase the risk for hyperkalemia. The angiotensin-converting enzyme or ACE inhibitors end with P-R-I-L. Examples include lisinopril or fosinopril, and the names of the angiotensin receptor blockers, the ARBs, end with S-A-R-T-A-N, Losartan or irbesartan are examples of ARBS. And we need to remember that they also reduce the excretion of potassium into the urine and we will need to limit the dietary potassium in the diet when the level is high, when the patient has hyperkalemia.

Many people that we serve do not know that the abnormal potassium levels can be dangerous for them. If levels go too low or too high, it can affect how the muscles work and how the heart beats.

Now, when I first mentioned potassium restriction, if we were all in the same room, I would ask you, "Which food groups do you think I mean when I talk about potassium restriction?" And I bet many of you might have thought fruits and vegetables, and you are correct, fruits and vegetables do contain potassium. I am hoping you also were thinking salt substitutes since I did mention that they needed to limit those as well. But here on the bottom, you see graphics of more than fruits and vegetables. You see meat, milk, and nuts. So I am here to tell you that any food that has protein has potassium in it naturally.

I'm kind of bouncing back a little bit between sodium and potassium and everything, but just to let you know, when we're looking at food labels and trying to lower sodium, because that is the first step, we need to let people know that lower sodium items may have potassium chloride in place of salt. Here on the left, you see regular canned vegetable soup; and on the right, low sodium canned vegetable soup. You can see that the sodium in blue goes down in the low sodium type, but you can see that the red bar, the potassium goes up. So they have taken out the salt and they've replaced it with potassium chloride. So we need to have people know they need to check the ingredient list for potassium chloride in lower sodium items.

Now, interestingly, I stopped at the Food Distribution Program to check labels before I did this webinar for you, and I have noticed that the cold cereals have potassium chloride in them, just for your information. I cannot tell you how much there is because I didn't look at that specifically, I just looked at the ingredient list.

All right. So now I am going to move on to protein because I just mentioned to you that proteins have lots of nutrients, including potassium. So this graph here is showing that most of us in this country are eating more protein than we need, and I believe that most of us who work with people who have diabetes are seeing that people are eating fewer carbs to manage their glucose levels and they are eating more protein instead. So they may be eating even more than what we see here based on age and gender.

Now, on the far left, you see the RDA, the recommended daily allowance for protein. That is 46 grams of protein per day for the reference woman and 56 grams of protein for the reference man. Now, one ounce of meat has about seven grams of protein. So if I eat a six-ounce steak, I get 42 grams of protein. That is almost what I need for the whole day and we need to keep in mind that we can only make so much protein in a day. If I eat more protein, it does not get stored as protein or muscle. The extra calories get stored as fat and my kidneys have to get rid of the extra nitrogenous waste, the extra potassium and the extra metabolic acids and the extra phosphorus that are in the protein.

You have probably already figured out that I was going to tell you that high protein diets are not recommended for people with diabetic kidney disease. In particular, if someone has a high level of urine albumin, they should not be eating a high protein diet. It's really the animal protein that may be more of a problem. It actually may be a risk factor for albuminuria in people who have hypertension and diabetes. That's just the group I am talking about here.

When any of us eats a big piece of meat, that filtration rate in the kidneys goes up for a time afterwards. This is a transient increase in the GFR and the way I look at that is my kidneys rev up to get rid of all the extra nitrogen and other substances that are in the proteins. And animal protein may have a greater effect in that hyperfiltration. I've already mentioned that proteins have many nutrients, the nitrogen, phosphorus and potassium. And animal protein does have -- it produces more metabolic acid in our blood due to the metabolism of sulfur-containing amino acids, and some proteins do have salt added to them. So if we think of canned meats or canned fish, rotisserie chicken, fast food chicken, canned beans, salted nuts, salted sunflower seeds. That is why we went with salt as being the first thing to reduce. If we reduce the sodium, we might reduce a lot of these other things as well.

I mentioned I was going to go through some of the food groups, so let's look at the nutrient profiles of protein foods. Now, these are the averages they used when they developed the old food pyramid so that you can see the meats and the poultry, the ounce, they're small portions, and you can see that if we look at the sodium column, certain foods do not have a lot of sodium. These beans and the peas must be made from scratch, certainly not canned, and then the nuts and the seeds further down are also unsalted. Then if you look at the phosphorus column, you can see that all of these protein-rich foods, with the exception of egg white, have phosphorus. Then when you look down the potassium column, you see the same thing. All these protein-rich foods have protein, some have sodium, they all have some phosphorus, and they have potassium.

When I am framing this for the patient, you look and say, "Okay, one ounce of meat only has 62 milligrams of phosphorus." Well, if I eat a 6-ounce steak, that is 360 milligrams of phosphorus, and I get over 600 milligrams of potassium from that steak. So that is why we need to eat smaller portions of the protein-rich foods.

Now, I know many of us are using this graphic, the "My Native Plate" to educate people about how to eat healthy, and certainly filling a quarter of the plate with a lean protein is going to be a great idea. That's a very sensible and reasonable method to use, because we do want people to eat the right amount and the right type of protein. The RDA for protein is about 0.8 grams per kilogram body weight and what you may see as people's GFRs go down; they will not want to eat red meat. In particular, it is the red meat. So, in the beginning, when someone has a higher albumin and a normal GFR, we want them to eat less meat, and once the GFR is low and they are feeling the effects of advanced kidney disease and they are not eating enough meat then we have to find the type of protein that they will eat.
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Now, people with kidney disease are at very high risk for cardiovascular disease and many will die from cardiovascular disease before they reach kidney failure. Now, the third step in the diet is to choose foods that are heart-healthy. I am not going to spend a lot of time talking about heart-healthy diets as I believe most of us know what that means. Step three is basically eat heart-healthy foods. However, I am going to take a few minutes to discuss the complications of chronic kidney disease that increase the risk for cardiovascular disease in people with kidney disease. High blood pressure is going to be a problem, certainly that's not a good thing for the heart and the anemia that may develop may result in left ventricular hypertrophy. It is certainly not good for the left ventricle of the heart to become enlarged. And the abnormal mineral metabolism of kidney disease related to the vitamin D, is a very complex complication. It may result in the bones getting soft and weak and the blood vessels getting calcified. As the GFR goes down, you may see lower serum bicarbonate levels indicating there is too much acid in the blood. You may see higher BUN levels showing higher blood urea nitrogen, and I got to tell you there is no one specific GFR that you are going to see all of these things happen, but all of these are risk factors for cardiovascular disease.

And certainly, if someone has a very low blood sugar, that will not be good for their heart. So, they may be experiencing more frequent low blood sugars if the kidney disease is progressing, and most people are not going to feel any of these complications. They are not going to feel any different until the GFR is about 25% of the normal level. They are not going to be able to tell their blood pressure is harder to control. They may not even realize they are anemic. They certainly will not feel any problem with their bones. They won't feel the toxins build up. That is why they need to come in and we need to keep monitoring them.

So I'm going to talk about anemia as the first complication to review, because people do not know that their kidneys are not making enough erythropoietin and they may be anemic. Anemia can cause fatigue, poor appetite, and certainly we want them to be able to walk, to be active, to get out of their chair, to pick up their grandchildren, and have fun. So, if someone is anemic, we need to know so the provider will be checking complete blood counts more often and if they identify the patient has anemia,

identified by a low hemoglobin level, then we'll need to check their iron status. Iron is just part of the recipe for healthy red blood cells.

Now, supplemental oral iron may be prescribed and as we all know, the iron supplements can cause GI upset. If they are taking iron for anemia and they are prescribed a phosphate binder that has calcium in it, they will need to take those medications at different times. Any kind of phosphate binder should be taken with meals, so by the process of elimination, that means the iron supplement needs to be taken between meals and that really makes it harder on the gut.

Now, you also may have heard that there are injectable erythropoiesis stimulating agents and intravenous iron, both are available and are more commonly used in dialysis. And the taste for meat may be impacted as I mentioned previously, and the only reason I'm am putting it on this slide is that red meat is one of the best sources of dietary iron.

Now, the abnormal mineral metabolism complication is really very complex and what your patient needs to know is there'll be more blood work and more medications. A low level of active vitamin D sets up a cascade of reactions. We all need active vitamin D to absorb calcium and people with CKD do not have as much active form because the kidneys are not making the enzyme needed to activate it. So their serum calcium levels go low and this hypocalcemia sets off the parathyroid gland to make more parathyroid hormone to pull calcium out of the bones.

The fibroblastic growth factor 23 controls serum phosphorus levels and in the future, we may be looking at that lab test to assess this particular complication. But at this time, the doctor will be checking the 25-hydroxy vitamin D level along with calcium and phosphorus and they may also check the intact parathyroid hormone level. The provider may also send the patient to a nephrologist, also known as the kidney doctor, to see if the patient has renal bone disease. I'm am always really surprised at how many people don't really understand what the nephrologist does until they come back and say, "I saw the kidney doctor."

As far as this complication is concerned, the patient will probably be prescribed another set of medications, a vitamin D supplement, and those phosphate binding medications I mentioned before. And I've said that the bones may get soft and the blood vessels may calcify, so this is a very dangerous complication. Active vitamin D increases the absorption of both calcium and phosphorus from the foods. So we will be needing to monitor those levels if patients are taking active vitamin D. I mentioned phosphate binding medications should be taken with meals. Now, I've got to tell you that there is a new phosphate binder that's come out on the market recently and it is iron-based. So we may be able to control phosphorus using this medication and they may not need to take quite as much supplemental iron.

And of course, when we're talking about the diet, I've mentioned that protein foods have phosphorus. So if people are decreasing their protein intake, they are decreasing their phosphorus intake at the same time. And there are phosphorus additives that are put into foods for various reasons and that added phosphorus is absorbed much more efficiently than the natural phosphorus. When I mentioned how much phosphorus there was in an ounce of meat, not all of that phosphorus is absorbed into the body. But if it's a meat that has a sodium phosphate added to it to keep it moist and tender, the body will absorb almost all of that added phosphorus. So what we want them to know is they should avoid foods and beverages with added phosphorus. All we need to do is look for P-H-O-S on the ingredient list to identify foods that have added phosphorus.

Now metabolic acidosis basically means too much acid in the blood or acidemia maybe another term that you've heard so the damaged kidneys are unable to make enough base, bicarbonate, and they cannot excrete the extra acid, or the hydrogen ion. So when we see a low serum bicarbonate level less than 22 mEq/L, we may be seeing chronic metabolic acidosis. And the metabolic acidosis may cause

muscle degradation, reduced albumin synthesis, worsening of the bone disease, and it may impair glucose tolerance.

So the provider may prescribe another medication, a supplemental base such as sodium bicarbonate. So if the patient has been prescribed sodium bicarbonate, we need to review the sodium in the other foods to make sure they decrease their dietary sodium intake from the foods, because they really need to take the medication to replace the bicarb. When I talk to people about this, I tell them that the sodium bicarbonate helps protect their kidneys, and it's not exactly true but it really does make a difference because when I see the serum bicarbonate increase above 22, I also see their serum albumin increase.

Okay. So now I'm going to move on to the more specifics about diet. I am here to tell you that carbohydrates still count, even though step one might be sodium, we're still talking about carbohydrates because that has an impact on their glycemic control. It does not change in kidney disease, 15 grams of carbs is still one carb choice or one carb unit. And we all know that starches include starchy vegetables, and peas, and potatoes, fruits, milk, and added sugars, they all still contribute to the carbohydrate load. But what we need to do is we need to look beyond the total carbohydrates and consider the other nutrients that are within these groups.

So here are the averages that they used when they developed the food pyramid. Now you've already seen the list for the protein foods and here at the top, you can see the grains. We all know that whole grains have more nutrients compared to refined grains. That includes more phosphorus and more potassium. Now remember, I mentioned that not all of the phosphorus that is found naturally in food is absorbed. So if someone was to eat an ounce of this whole grain bread that says it has 85 milligrams of phosphorus, we cannot tell how much phosphorus is absorbed into the blood. However, if there was an added phosphorus additive to it that phosphorus would be absorbed almost 100%. And you can see further down the vegetables, they're not a big source of protein except the beans and the peas. You can see they are not high in sodium, they're not particularly high in phosphorus, and they certainly do contribute to potassium. And the fruits and the juices again are not rich in protein or sodium or phosphorus and they certainly vary in potassium. Now, milk is a protein rich food. It has sodium, phosphorus and potassium as you can see. And then oils, added sugars, and solid fats, they do not contribute much to any of those nutrients.

So now, we need to look at those carbohydrate groups again and just frame it when we're looking at CKD. They still count but they're not just carbohydrates. So milk is rich in nutrients. This does not mean they cannot drink milk. It just means maybe they need to have smaller portions of milk and yogurt. And the processed grains, remember that was that white bread or bread that contributed the most to sodium intake. And the whole grains as you saw in the previous slide, they have more phosphorus and potassium. And the dried beans and peas, the legumes are very rich in nutrients, and hopefully people are not adding salt, or salt pork, or bacon, or canned luncheon meat to those beans when they make them. And the starchy vegetables such as potatoes are a source of potassium and I am pretty sure everybody knows that if we boil the potatoes, potassium leaches out of the potato and goes into the water. Frying and baking does not remove the potassium. So cooking in water may remove some potassium from those starchy vegetables like potatoes.

Interestingly, canned fruits may have less potassium than the fresh fruits because the same thing happens. The potassium leaches out of the fruit in the can and it goes into the water or the juice that that fruit is packed in. Now, some sweets and added sugars may have added phosphorus, and I bet most of you know that colas have phosphoric acid. That is added phosphorus.

So now, I will move on to phosphorus. And when we eat all that protein and when we eat all those processed foods that have added phosphorus, we certainly can get more phosphorus than we need. So the recommended daily allowance is 700 milligrams a day. If you do find a percent daily value for

phosphorus on the nutrition facts label, it's based on 1000 milligrams. But you can see here that men and women, all ages, eat more than the 700 milligrams on the RDA. On average, women take in about 1,200 milligrams and men have over 1,600 milligrams per day of phosphorus.

So, step four is to choose foods with less phosphorus. So if they are decreasing their protein intake, they are decreasing their phosphorus intake and not all of it is absorbed from the natural sources. However, those food additives can really contribute to phosphorus intake. So that includes additives, dietary supplements, and foods that are fortified with calcium. This slide shows you a few more of the products that may have added phosphate. You can see cake mixes, waffle mixes, fruit juices, extruded dry cereals, also known as cold cereals. Those have tricalcium phosphate. That's for the calcium fortification. So, many foods have added phosphates, not just colas.

So again, if we want them to identify foods that have this added phosphorus, they need to just read the ingredient list and look for any word with P-H-O-S because phosphorus is not required on those nutrition facts labels and even if it was, we wouldn't be able to tell how much of it got absorbed. So if you do find a food that has P-H-O-S in it, it would be better to choose a different product if they can.

Now, you probably remember that chicken was the second source of dietary sodium, so let's just take a look at some chicken products, and on the far left, you see raw chicken. The red bar is sodium. The yellow or goldish bar is phosphorus and the blue bar is potassium. So you can see the raw and then the raw enhanced. There is more sodium and there is more phosphorus in the chicken that has been enhanced to keep it moist and tender. Certainly, the rotisserie chicken looks like it has been enhanced because there is certainly a lot of sodium and phosphorus in it and just like when we boil potatoes and some of the potassium is removed, when we stew the chicken some of the potassium and the phosphorus goes into the broth. And I am not going to spend a lot of time on the fast foods because we all know those are sources of sodium in the diet, but this might explain why the chicken is such a big source of sodium in our diets. Not everybody is going out to fast foods, but people, even if they are cooking fresh chicken at home, it may have added phosphorus, sodium phosphorus, sodium phosphates actually.

All right, so then we are going to step five, which is choose foods that have the right amount of potassium. For you providers, I would flip it and limit and say limit potassium when the dietary potassium is high, and you've just heard more than you want to about how much potassium there is in protein-rich foods so I'm pretty sure you'll remember that, and you know that fruits and vegetables are a source, and salt substitutes, and low sodium foods with salt substitutes may need to be avoided. We do need to keep in mind that herbs and dietary supplements can also contribute to daily potassium intake. Now, not many CKD patients are taking potassium supplements like potassium chloride or potassium citrate, but certainly, our patients with diabetes may be taking the ACEs and ARBs. So we do need to be looking at the medication list, looking at the potassium levels and when the potassium level is high, start telling them more about this reduction in potassium-rich foods. But again, if we start with protein and we don't want to start limiting the fruits and vegetables until the end, so that is why we're looking and focusing on protein before we start cutting back on fruits and vegetables.

All right, so if we're going to be talking to people about treating hypoglycemia, which food, which beverage here would be the best one. Certainly, we're not going to be using diet cola to treat a low blood sugar, but I wanted you to see that indeed, the diet cola does have some phosphorus in it and of these items, the one that would be the best would be the lemon-lime soda pop because it doesn't have phosphorus additives and it is not high in potassium. You can see the milk and the protein-fortified milk, which is basically milk with nonfat dry milk powder added to it. That has the highest of any of those as far as the nutrients I've been talking about, sodium, phosphorus, and potassium.

Now, I'm just going to go through a couple meals. So why is it important to prepare foods from scratch? You can see that four-inch pancake, that one-carb choice has sodium, phosphorus, and

potassium and if we're making it from a mix, whether it is a white flour or a whole wheat mix, those nutrients, the sodium, the phosphorus and the potassium increase and if we only eat one of those three hotcakes, you can see we get still those nutrients.

I've mentioned before that egg whites are low in phosphorus. Here, you can see that they are still the lowest choice as far as phosphorus is concerned in this set about eggs. Now we're not eating raw eggs, but this just shows you that the egg white is not the source of phosphorus and you can see the commodity dry egg mix does have some sodium, does have phosphorus and does have a little bit of potassium in it. Many people are using those egg substitutes in place of eggs because they don't want the cholesterol in the egg yolk. Those are a source of sodium and phosphorus and potassium because they have to have additives to keep them safe. And then, of course, if we eat at fast food places, we're always going to get more fat, more salt, apparently, more phosphorus and some potassium in some cases.

I keep talking about enhanced, so let's just look at the pork tenderloin plain and enhanced. You can see that the sodium content increases quite significantly per 100 gram serving of cooked pork tenderloin and the phosphorus and the potassium are also higher in the enhanced product compared to the non-enhanced product. And the soymilk can have sodium and if it is fortified with calcium, it may be calcium phosphate that they fortify it with, so the fortified product has more phosphorus. And the only reason I have this chocolate soymilk is that chocolate, no matter where it is, is a source of potassium. These choices, the orange juice versus the calcium fortified orange juice, you can see that the fortified orange juice does have more phosphorus in it, probably because they used calcium phosphate to fortify it with calcium.

All right, now, the other thing that you may see is that as the GFR goes down, the person's A1C may go down as well and the person may not be doing anything different. They may not change their diet, they may not exercise more. The doctor may not have changed their medications. If you see the A1C go down without any specific reason or the person is having more frequent low blood sugars, that may show that the CKD is progressing, that the GFR is going down.

So I've been talking about treating hypoglycemia with lemon-lime soda pop instead of colas. So certainly, we want people to know how to treat a low sugar correctly, so check the medication list for ACE or ARBs. If those are prescribed, glucose tablets will work just fine if the patient will take enough glucose tablets in a short period of time because I just don't see them eat those quickly enough. Or they can use a low potassium juice. We want them to avoid colas and any other beverages with added phosphoric acid. You've already seen that milk is a source of many nutrients including phosphorus and potassium, and chocolate. Although people might want to treat a low sugar with a chocolate candy, it will take longer and they will be getting some potassium as well.

We need people to know that any kind of juice can treat hypoglycemia even if those are low in potassium. And here, you can see the cranberry cocktail, cranberry juice cocktail, which really isn't a juice; it is low in potassium. And orange juice as you scroll over, you can see is a significant source of potassium, and a half a cup is about 230 milligrams. And in reality, let's consider, do people really only drink a half cup of juice when they're treating a low blood sugar? So sometimes, even these low potassium foods can become a high potassium item based on quantity.

All right, so let's get back to T.C. and wrap this up. So T.C.'s kidney disease progressed quite rapidly. You remember his urine albumin to creatinine ratio was quite high, it went down and then it went back up and you can see on the right, his GFR went from normal to about 27 in two years. So we need to keep checking the nephropathy assessments, the UACRs and the GFR.

To summarize the steps for eating right, carbohydrates still count. If they are going to be treating a low sugar, make sure they're treating it appropriately, use a low potassium juice. You now know that whole

grains do have more phosphorus and potassium than those refined grains and not all of the phosphorus in the whole grains are absorbed, so they can still have some whole grains. The first step beyond the carbs is to choose and fix foods with less salt and sodium. So have them check the ingredient list for sodium and if they are a lower sodium item, they may also need to read the ingredient list to make sure that it's not potassium chloride in place of sodium chloride.

I've already talked enough about protein, so you know eating less protein will reduce the amount of phosphorus, potassium, and nitrogenous waste that's in the body, and if we eat less animal protein, we will reduce the metabolic acids as well. And many of those processed proteins may have added sodium.

We want them to choose foods that are heart healthy. We don't want them to fry a lot, we want them to trim the fat from the meat and cook in heart healthy ways. And if they've eaten less protein, they are eating less phosphorus, so the next step would be to look at the packaged and processed foods, or the chicken or the poultry or the pork that have phosphorus added to them, check for P-H-O-S on the ingredient list.

When we're treating a low sugar, consider colas have phosphoric acid, milk substitutes and bottled teas may have added phosphorus, and milk has natural phosphorus. I'm telling you that we need to limit the dietary potassium when the serum level is elevated. What the "Eating Right for Kidney Health" handout says is choose foods with the right amount of potassium. Again, if the ACEs or ARBs are used, it's going to increase the risk for hyperkalemia. Use glucose tablets, if they'll get them in soon enough, eat them quickly enough, or a low potassium juice.

These are just some of the items that you can get from the National Kidney Disease Education Program. "How Well Are Your Kidneys Working", you've seen some of those graphics in my slide. There is a whole handout on "Eating Right for Kidney Health" that has all of the steps that I've described to you but in much simpler language. On the far right, you see the "Kidney Test Results", which can be used for patients to discuss their labs. And for those of you who don't see people with kidney disease very often, this might be a helpful tool to you to remember, "Oh yeah! I got to check the calcium. Oh yeah! I got to check for anemia", because all of those complications that I mentioned are covered on those test results handout. There are also individual fact sheets available about sodium, protein, phosphorus, potassium, and "How To Read the Food Label" and in addition, there is what we call the "Assessment, Management and Treatment Guide" available from NKDEP as well. This is new. This came out in July. This is for primary care providers, "Making Sense of CKD", and it covers may of the same topics that I've talked about, anemia, metabolic acidosis, how to identify chronic kidney disease, looking at the urine albumin to creatinine ratio. So, if you have a minute, go to NKDEP and check this out – www.nkdep.nih.gov